Biomass to Liquids: California and North America

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James D. Boyd
Vice-Chair and Commissioner
California Energy Commission

Presentation Outline

- Why Biomass to Liquids?
- Current State of Biofuel Industry in the US and California
- Strategic Value of Biomass Resources
- California Governor's Executive Orders on Biomass and Climate Change
- State Legislative Initiatives affecting Biofuels
- Biomass as a Source of Transportation Fuels

Why Biomass to Liquids?

Global Energy Security

Environment

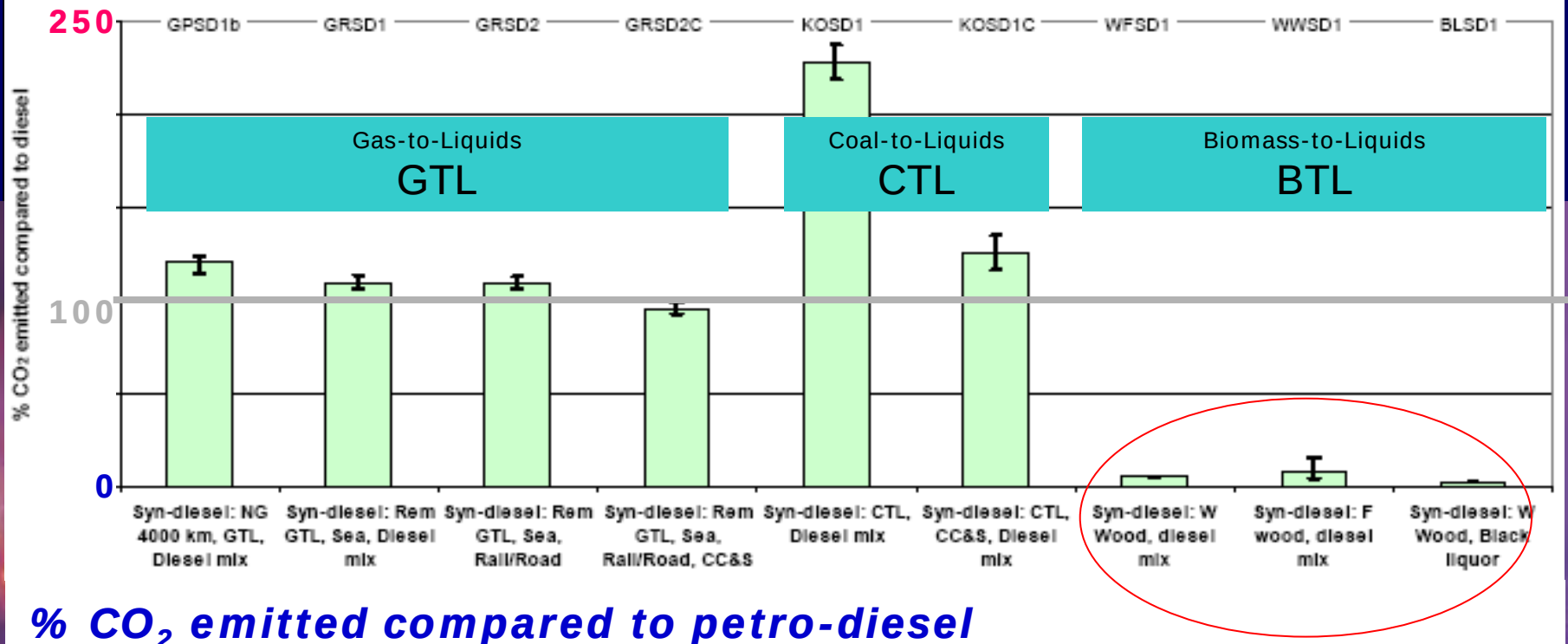
Economy

- Rural Economy
- Balance of Trade
- National Debt

Energy Price Stability

California Energy Commission

Net CO_2 Emissions for Syndiesels



% CO_2 emitted compared to petro-diesel

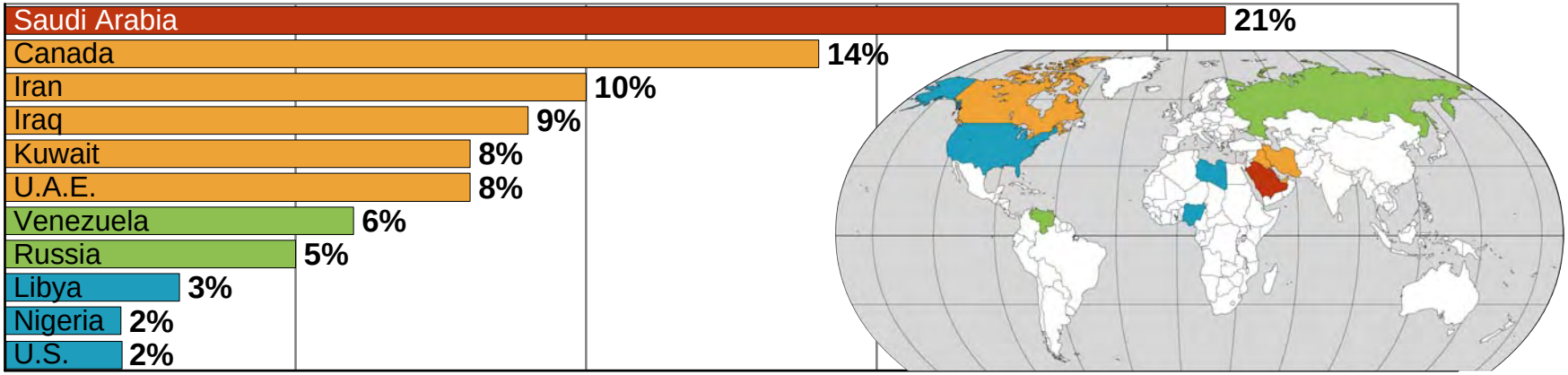
WELL-TO-WHEELS ANALYSIS OF FUTURE AUTOMOTIVE FUELS AND POWERTRAINS IN THE EUROPEAN CONTEXT (May, 2006)

http://ies.jrc.cec.eu.int/media/scripts/getfile.php?file=fileadmin/H04/Well_to_Wheels/WTT/WTT_Report_030506.pdf

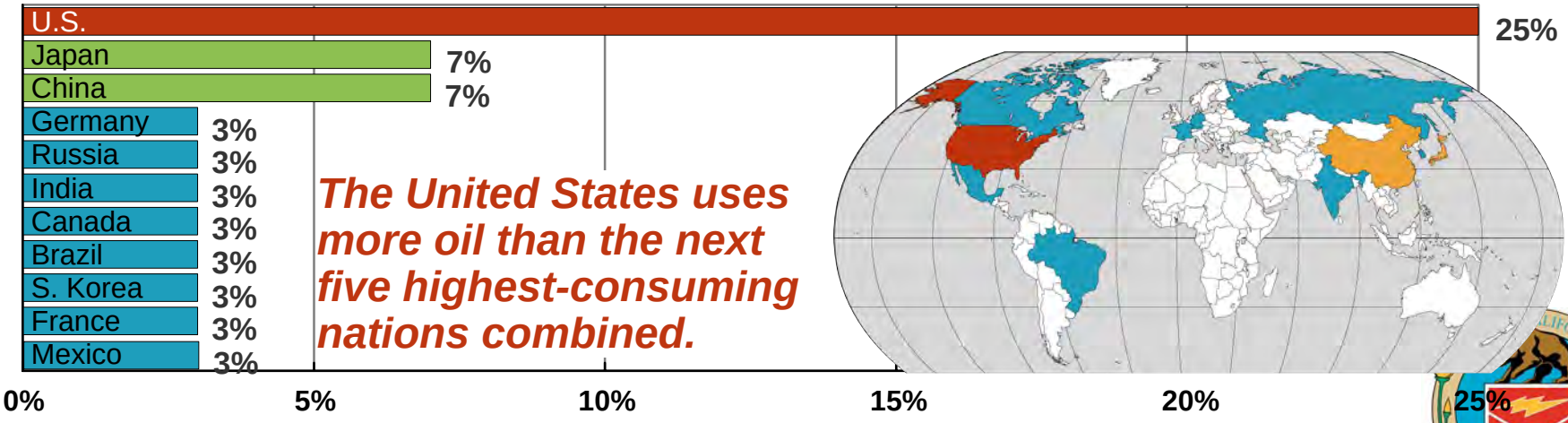
Image: http://www.fischer-tropsch.org/

U.S. Dependence on Foreign Oil

Oil Reserves



Rate of Use



The United States uses more oil than the next five highest-consuming nations combined.

Updated July 2005. Source: International Energy Annual 2003 (EIA), Tables 1.2 and 8.1-O&GJ. Canada's reserves include tar sands.

2005 U.S. Fossil Transportation Fuel Consumption (gallons)

Gasoline	140,000,000,000
Diesel	40,000,000,000

Current petroleum imports: 12 million barrels/day

At mid-July peak of $78.26/barrel, annual oil import bill is $342 Billion

On September 27, @ $61.54/barrel, annual bill is $269 Billion

Current State of the Biofuels Industry In the U.S.

- Most ethanol available today in the U.S. is corn, or grain, based ethanol.
- U.S. ethanol production is increasing annually from 1.1 bgy 1996 to 4.9 bgy 2006 with an additional 0.5byg to come on line before the end of the year.
- Total Number of U.S. E85 Fueling Stations: 841
- Estimated number of FFVs in service in 2006 is 6.2 million, up from approximately 0.5 million in 1999.

Data: Renewable Fuels Association, Alternative Fuels Data Center

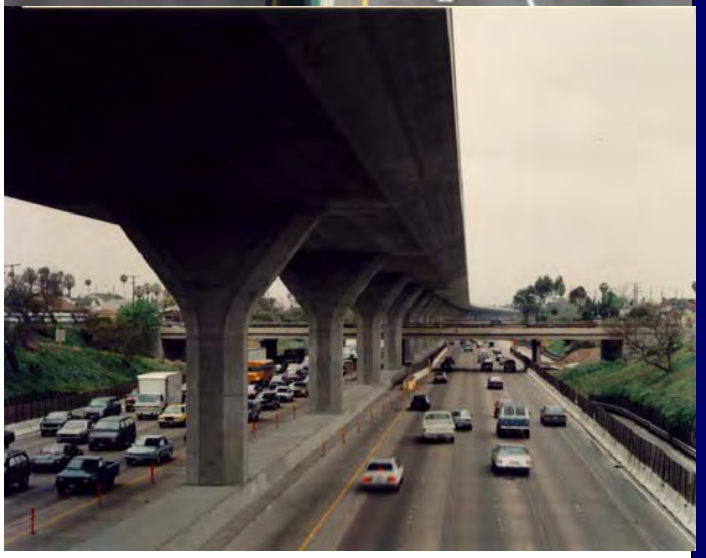
Biofuels in California Transportation

California is about 95 percent petroleum dependent.

California consumers over 900 million gallons per year of ethanol and over 11 million gallons of biodiesel fuel.

California's biomass resources can support 2 billion gallons per year and up to 3 billion gallons per year by 2020.

Biomass-based fuels can contribute to reducing our state's petroleum dependence, while decreasing air pollution and greenhouse gases.



Strategic Value of Bioenergy

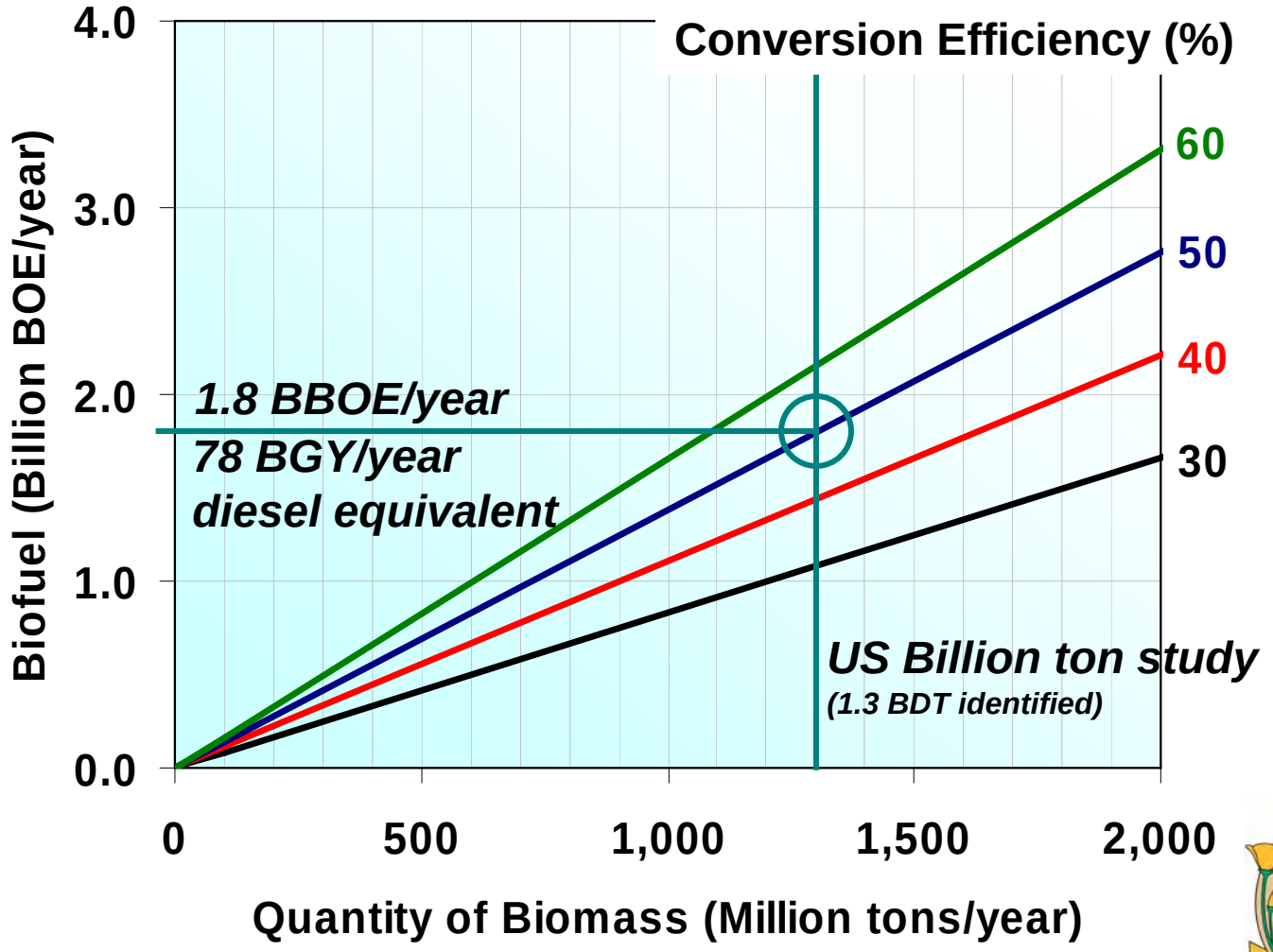
The U.S. has large, diverse and untapped biomass resources which can support greater use in electric power, fuels and chemicals.
U.S. Potential = 1.3 billion tons
California = 80 million tons

Biomass is an energy resource capable of achieving state petroleum reduction, climate change, renewable energy and environmental goals.

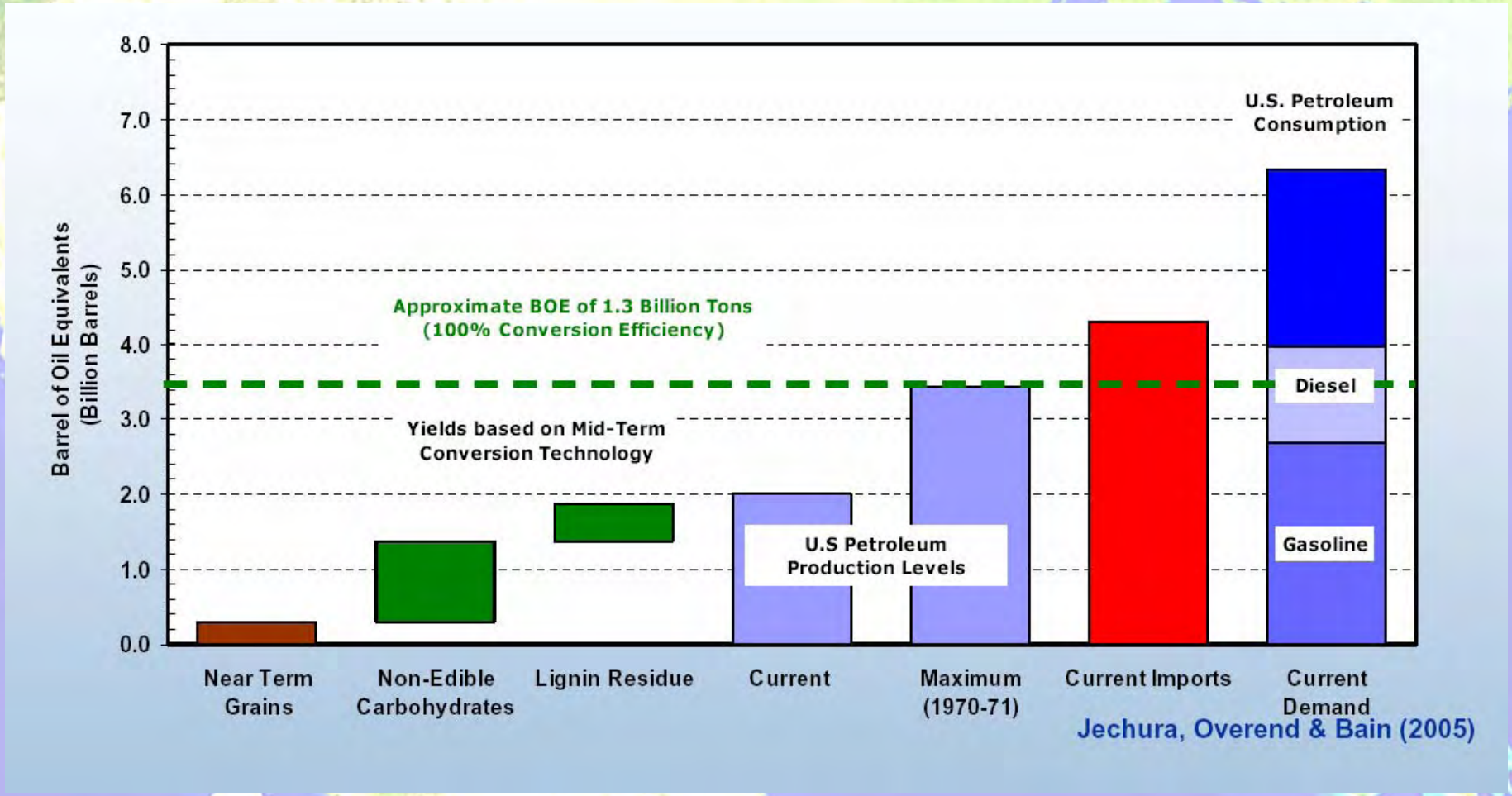
Use of biomass for energy production can address the U.S. and California's waste disposal and environmental problems, while creating local jobs.

Other public benefits include improving forest health and human and animal health, while avoiding catastrophic wildfires.

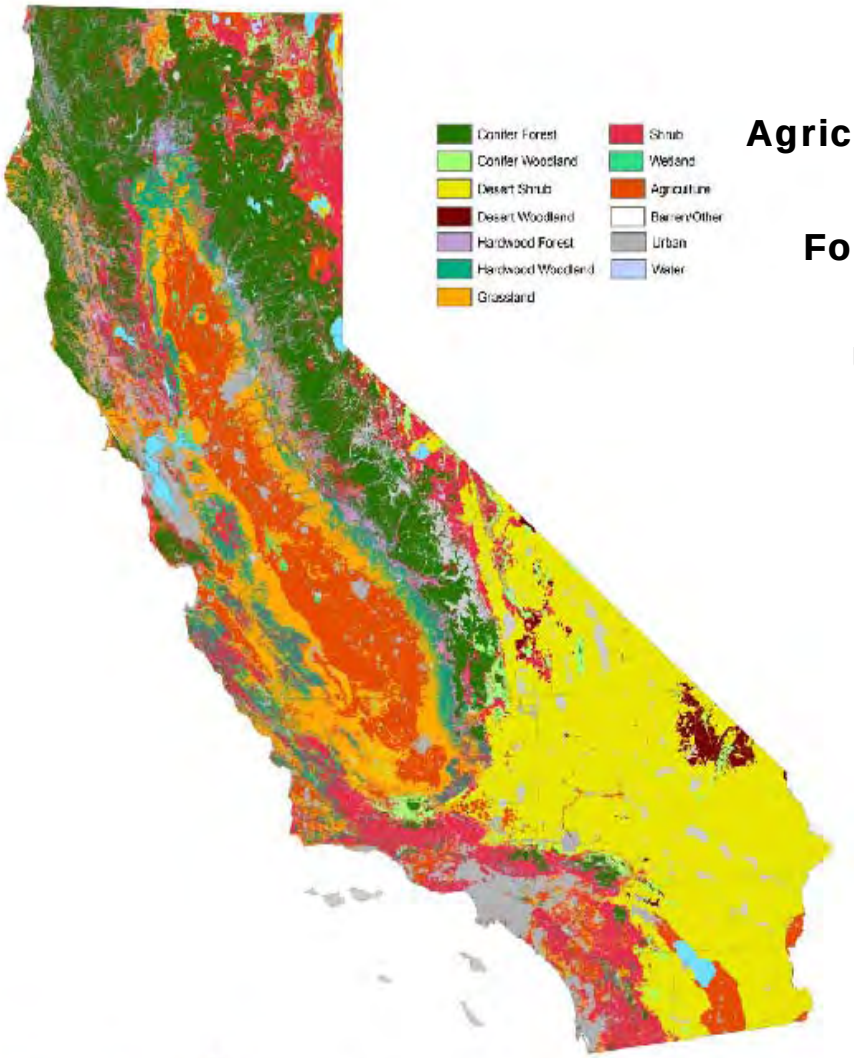
U.S. Biofuel Potential

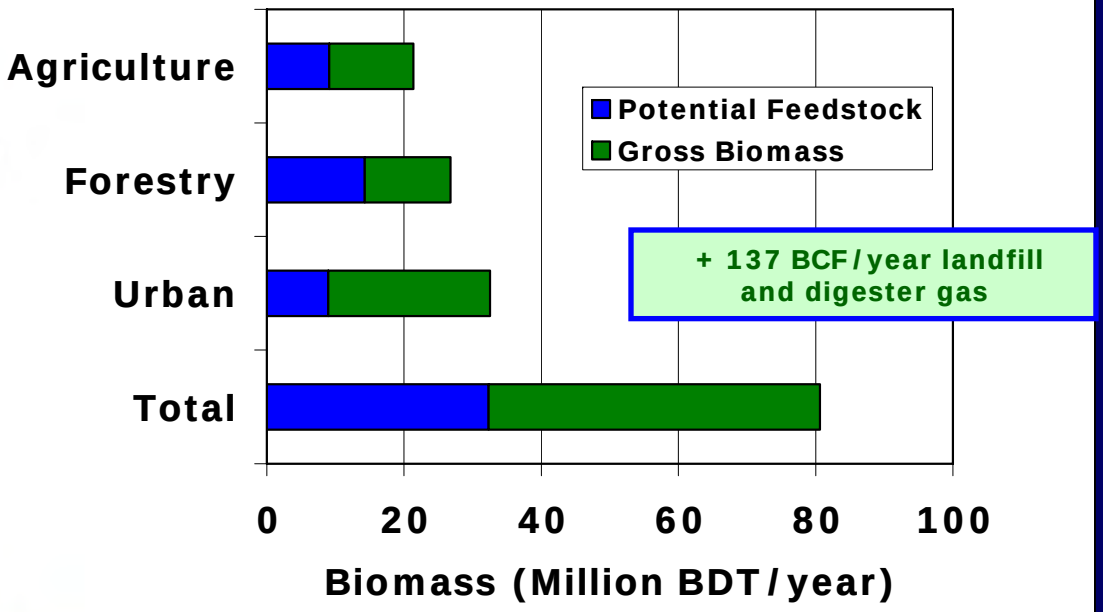


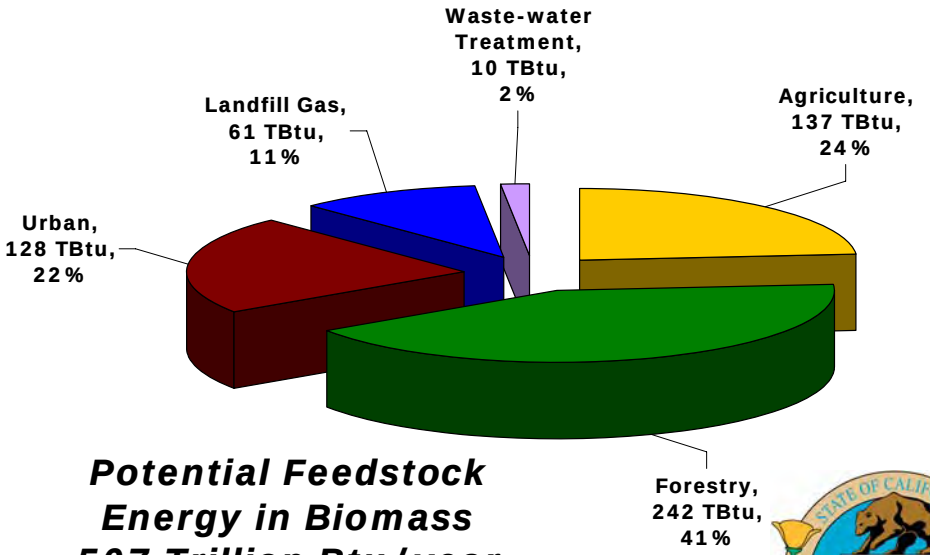
Biofuel Potential in U.S. Transportation



source: Bain, 2005







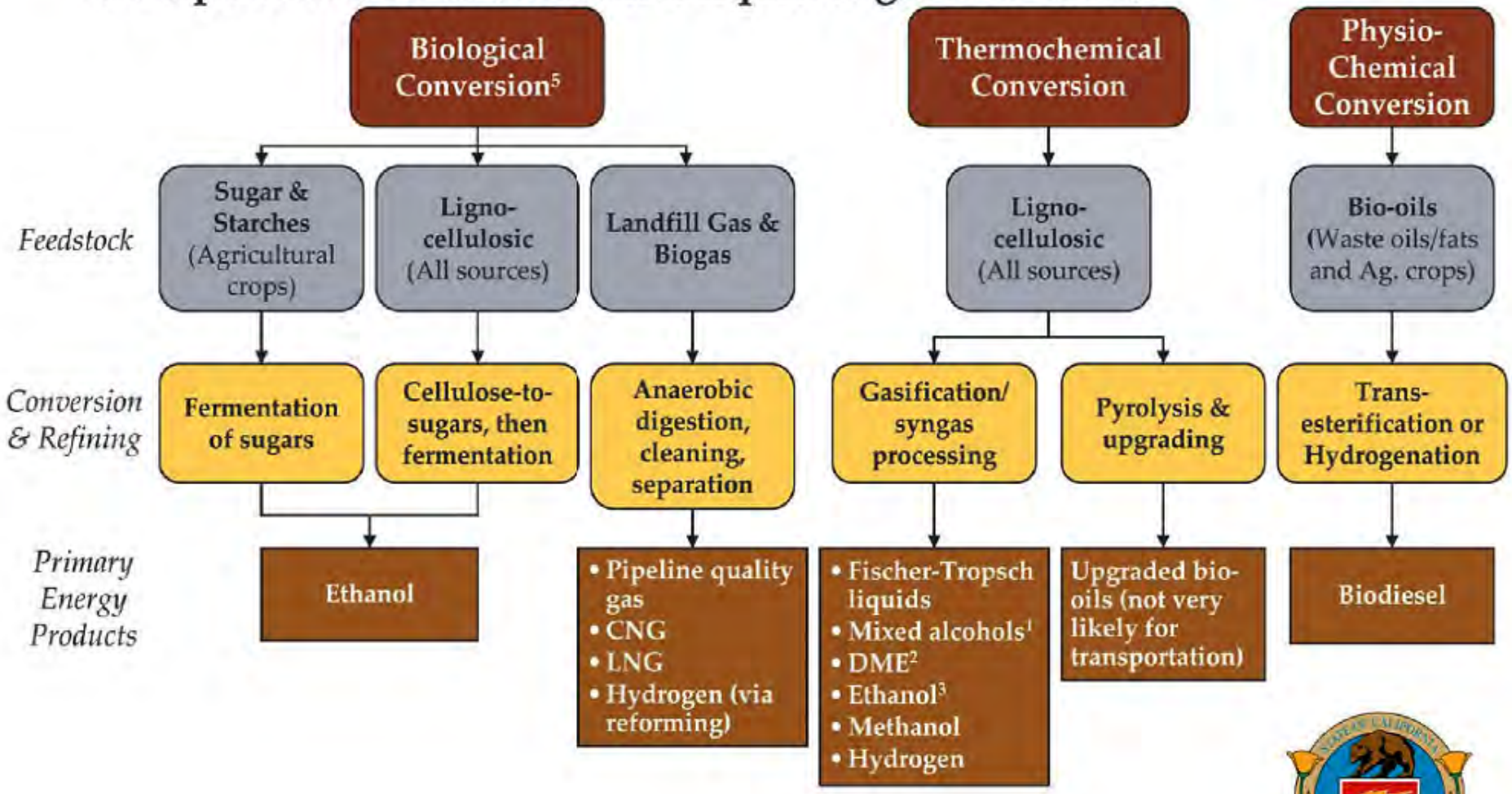
California Vast, Untapped Biomass Resources

Potential Feedstock Energy in Biomass 507 Trillion Btu/year

Conversion pathways to convert biomass residues to transportation fuels

Biofuels » Options for Conversion and Refining

Using the four major feedstocks there are multiple pathways to create transportation fuels (and other liquid & gaseous fuels).

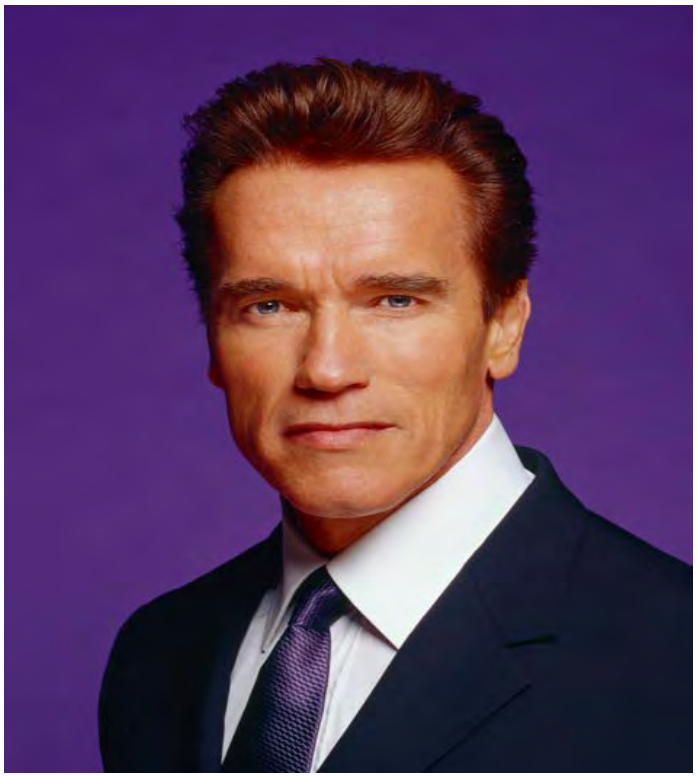


Governor Directs State Agencies to Expand Biofuels to Fight High Gasoline Prices

"It is critical that we do everything we can to reduce our dependence on petroleum based fuels. "

"Turning waste products into energy is good for the economy, local job creation and our environment."

---Governor Schwarzenegger
Sacramento, California
April 25, 2006



Governor's Executive Order S-06-06

Established targets to increase in-state production and use of bioenergy, including ethanol and bio-diesel fuels made from renewable resources:

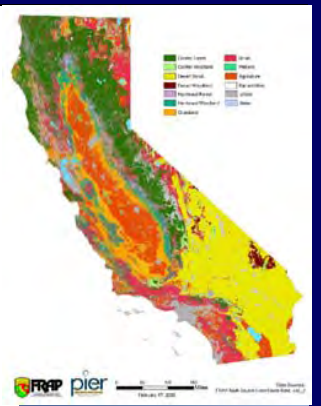
- **For biofuels**, the state shall produce a minimum of 20 percent of its biofuels within California by 2010, 40 percent by 2020, and 75 percent by 2050.
- **For biomass for electricity**, the state meet a 20 percent target within the established state goals for renewable generation for 2010 and 2020.

Governor's Executive Order S-06-06

Directed the California Resources Agency and the Energy Commission to coordinate work among state agencies to promote the use of biomass resources:

- Continue the work of the Bioenergy Interagency Working Group, chaired by the Energy Commission.
- Identify and secure federal and state funding for research, development and demonstration projects.
- Advance the use of biomass resources for electricity generation and biofuels for transportation.

State Action Plan Objectives



1. Establish California as a market leader in technology innovation, sustainable biomass development, and market development for bio-based products.

2. Coordinate research, development, demonstration, and commercialization efforts across federal and state agencies.

3. Align existing regulatory requirements to encourage production and use of California's biomass resources.

4. Facilitate market entry for new applications of bioenergy including electricity, biogas, and biofuels.

5. Maximize the contributions of bioenergy toward achieving the state's petroleum reduction, climate change, renewable energy, and environmental goals.

State Legislative Direction

The Governor signed Assembly Bill 1007 (Pavley, Chapter 371, Statutes of 2005) on September 29, 2005, requiring the Energy Commission to:

- Develop and adopt a State Plan to Increase the Use of Alternative Fuels no later than June 30, 2007.
- Work in partnership with the Air Resources Board and affected state agencies.
- The Energy Commission has a proceeding underway to complete the Plan.

Climate Change Initiative

"I say the debate is over. We know the science. We see the threat. And we know the time for action is now."

Governor Schwarzenegger, June 1, 2005

On July 1, 2005, the Governor signed Executive Order S-3-05 on Climate Change - establishing the statewide greenhouse gas (GHG) emission reduction targets:

By 2010, Reduce to 2000 Emission Levels
By 2020, Reduce to 1990 Emission Levels
By 2050, Reduce to 80% Below 1990 Levels

On September 27, 2006, the Governor signed Assembly Bill 32 (AB 32), the Global Warming Solutions Act of 2006. This initiative limits greenhouse gas emissions that will favor low-carbon technologies, including the increased use of alternative fuels, such as biofuels.

Alternative Diesel Fuels

U. S. fuel suppliers are producing alternative diesel fuels that are available for use in vehicles today.

Biodiesel is a renewable fuel being produced in the U.S. from vegetable oil, animal fat, or waste vegetable oils.

Gas-to-liquids is a synthetic diesel that uses Fischer-Tropsch technology to convert natural gas or synthetic gases (i.e. from gasified coal, petroleum coke or biomass.

Ethanol-diesel fuel blends (E-diesel) contains between 5 and 15% ethanol and a fatty acid-based additive.

Biodiesel

Biodiesel production in California is growing, reached 11.6 million gallons in 2006.

Biodiesel blends of up to 20 percent (B-20) are allowed under state fuel specifications set by the California Air Resources Board.

Today, most vehicles can accept up to 5 percent biodiesel (B-5), using existing diesel engines.

Biodiesel qualifies as an “alternative fuel” which can meet federal fleet requirements under EPACT.

Pure biodiesel (B-100) can be used in some engines without modification, although B-5, B-10 and B-20 blends are more common.

Ethanol

In the U. S., ethanol is blended into gasoline for use as both an oxygenate and an octane enhancer.

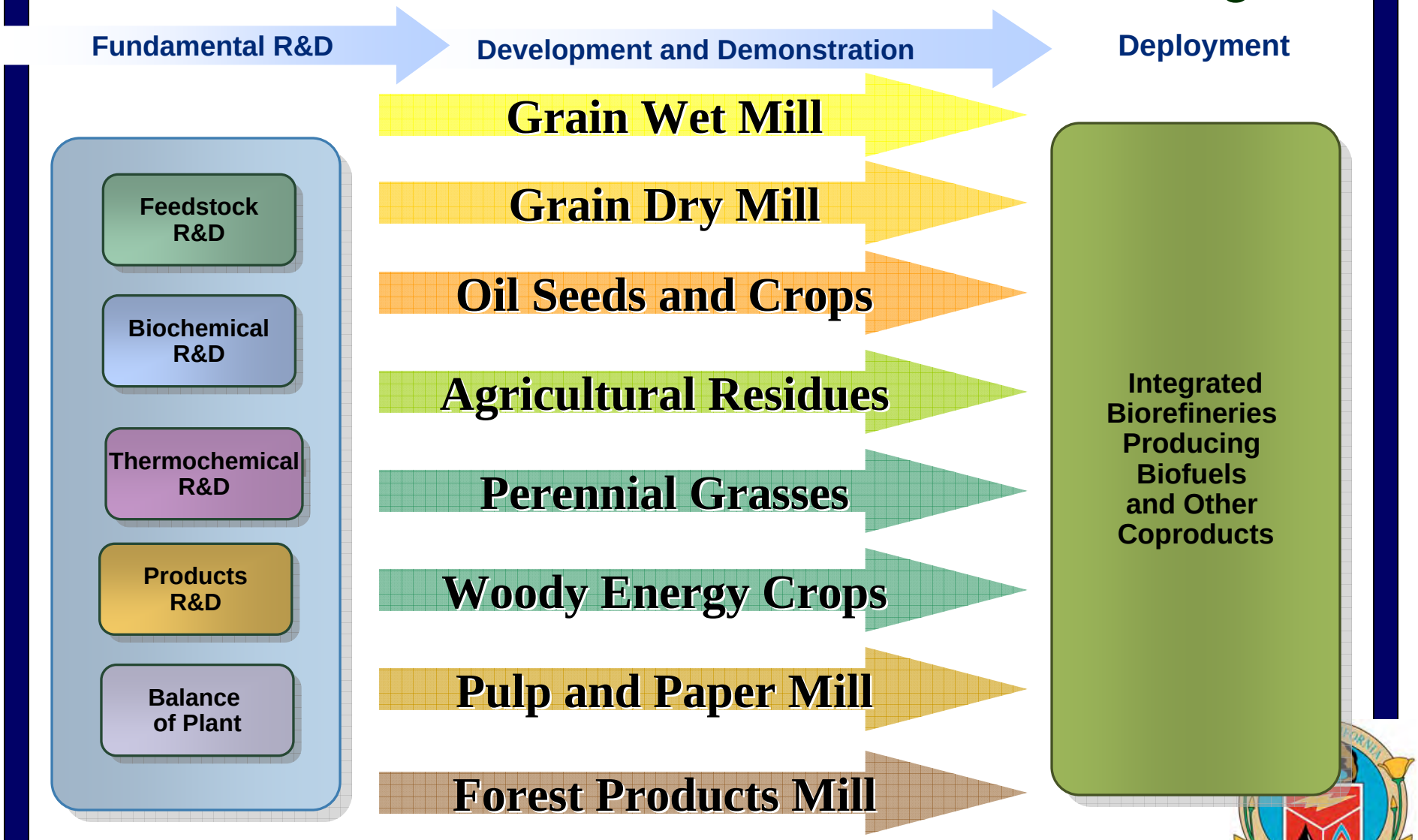
Ethanol has moved from a niche market in the Midwest to a national and ubiquitous component of the U.S. motor fuels market, 4.9 billion gallons production. Ethanol today is blended in more than a third of the nation's gasoline. Ethanol is used quite literally from coast to coast and from border to border.

U.S. DOE goals in response to Advanced Energy Initiative

2012 Goal: Fund additional research in cutting-edge methods of producing ethanol, not just from corn, but from wood chips and stalks, or switch grass. Our goal is to make this new kind of ethanol practical and competitive within six years

2030 Goal: Replace 30% of our current gasoline consumption with ethanol.

Producing Biofuels
U.S. DOE Office of Biomass Program



U.S. DOE/U.S. DA Cellulosic Biorefinery Solicitation

EPAct Section 932(d)

- Design, build, construct and operate a commercial-scale integrated cellulosic biorefinery
  - $160 million total funds ($53 million planned for FY 07)
  - 60% industrial cost share of project (minimum)
  - Up to three projects will be selected
  - Closed 8/10/06 with 24 applications received
  - Awards will be announced in December 06 or January 07
  - Awards pending FY07 appropriation
  - 4 of the 2002 solicitation award recipients are lead or partner in applications under review

U.S. DOE - Industry Deployment Efforts

Loan Guarantee (DOE Loan Guarantee Office)

- Announced by Secretary Bodman on August 7, 2006
- $2 billion in loan guarantees to help spur investment in projects that employ new energy technologies
- For more information: http://www.doe.gov/news/3897.htm

Reverse Auctions – stay tuned

Fueling Infrastructure (DOE Freedom Car & Vehicle Technologies)

- FreedomCAR and Vehicle Technologies Program solicitation: Refueling infrastructure projects that include new dispensing facilities, or additional equipment or upgrades and improvements to existing refueling sites for alternative fuel vehicles (AFV). $3.1 million will be available for the 16 selected projects.
- DOE Strategic Team on E85 Infrastructure

Other Renewable Transportation Fuels

Hydrogen can be produced from biomass, using a process called "reformation" to transform natural gas or landfill gas to hydrogen.

Biomass-to-liquid fuels are being pursued by some oil companies and fuel producers to convert biomass to a synthetic diesel-like fuel.

Methane is being converted from landfill wastes as a source of "biogas" needed for compressed or liquefied natural gas or pipeline quality natural gas.

Other Biofuels-Related Work Underway

The Energy Commission through the Biomass Collaborative has drafted a roadmap for biomass development in California that includes comprehensive RD&D for biofuels conversion technologies.

The Energy Commission is undertaking a special study of Biofuel Technology Development options. Using grant funding of $100,000 from the Western Governor's Association, we will complete an in-depth evaluation of biomass conversion technologies by mid-2007.

The Energy Commission will release a competitive grant solicitation by the end of October 2006. The intent of accelerating research, development and demonstration of biofuel technologies and refineries.

Results of this study and the Biofuels Solicitation will be made available on our Web Page at

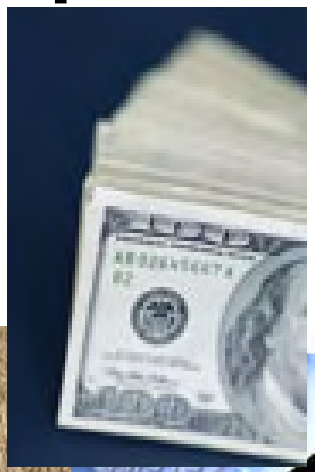
http://www.energy.ca.gov

What Must Happen For Biomass to Liquids To Become Commercialized?

Biomass To Liquids must be competitive

Biofuel Cost

- Feedstock
- Conversion
- Delivery



Fossil Fuel Cost

(Internalize the externalities)

- Security
- Environment
- Economy

RD&D Breakthroughs

Policy

Permitting